

WHAT IS CLAIMED IS:

1. A method of precipitating calcium carbonate, comprising:
 - (a) carbonating a mixture comprising a substrate and a first slaked lime slurry;
 - (b) combining the product of (a) with a second slaked lime slurry; and
 - (c) carbonating the product of (b).
2. The method according to claim 1, wherein the substrate is chosen from particles and fibers.
3. The method according to claim 1, further comprising:
 - (d) combining the product of (c) with a third slaked lime slurry.
4. The method according to claim 3, further comprising:
 - (e) carbonating the product of (d).
5. The method according to claim 4, further comprising:
 - (f) combining the product of (e) with a fourth slaked lime slurry.
6. The method according to claim 1, wherein the product of (a) comprises a precipitated calcium carbonate having a median particle size of at least about 0.5 µm.
7. The method according to claim 6, wherein the precipitated calcium carbonate has a median particle size of at least about 0.6 µm.
8. The method according to claim 7, wherein the precipitated calcium carbonate has a median particle size of at least about 1 µm.
9. The method according to claim 8, wherein the precipitated calcium carbonate has a median particle size of at least about 2 µm.
10. The method according to claim 7, wherein the product of (c) comprises a precipitated calcium carbonate having a median particle size of at least about 0.7 µm.
11. The method according to claim 10, wherein the precipitated calcium carbonate has a median particle size of at least about 1 µm.

12. The method according to claim 11, wherein the precipitated calcium carbonate has a median particle size of at least about 2 µm.

13. The method according to claim 12, wherein the precipitated calcium carbonate has a median particle size of at least about 2.4 µm.

14. The method according to claim 13, wherein the precipitated calcium carbonate has a median particle size of at least about 2.5 µm.

15. The method according to claim 1, wherein the product of (c) comprises a precipitated calcium carbonate having a BET surface area of about 6.0 m²g⁻¹ or less.

16. The method according to claim 1, wherein the carbonating in (a) and (c) comprises combining concentrated carbon dioxide with the mixture in (a) and the product of (b), respectively.

17. The method according to claim 1, wherein the carbonating in (a) and (c) comprises combining dilute carbon dioxide with the mixture in (a) and the product of (b), respectively.

18. The method according to claim 17, wherein the dilute carbon dioxide is flue gas.

19. The method according to claim 1, wherein the first and second slaked lime slurries each comprise calcium hydroxide in a concentration ranging from about 2% to about 30% by weight relative to the total weight of the slurry.

20. The method according to claim 1, wherein at least one of the first and second slaked lime slurries is degritted prior to the subsequent carbonating.

21. The method according to claim 20, wherein the degritting comprises at least one process chosen from screening, classifying, centrifuging, and hydrocycloning.

22. The method according to claim 21, wherein the degritting comprises screening the slaked lime slurry, followed by hydrocycloning the screened slurry.

23. The method according to claim 22, wherein the slaked lime is screened with a 60 mesh screen or finer.

24. The method according to claim 2, wherein the substrate comprises fibers.

25. The method according to claim 2, wherein the substrate comprises particles.

26. The method according to claim 2, wherein the substrate is chosen from a mixture comprising particles and fibers.

27. The method according to claim 25, wherein the substrate comprises a white particulate mineral.

28. The method according to claim 27, wherein the substrate comprises kaolin plates.

29. The method according to claim 27, wherein the substrate comprises kaolin stacks.

30. The method according to claim 27, wherein the substrate comprises precipitated calcium carbonate.

31. The method according to claim 27, wherein the substrate comprises ground calcium carbonate.

32. The method according to claim 27, wherein the substrate comprises talc.

33. The method according to claim 27, wherein the substrate comprises TiO₂.

34. A paper comprising a composition made according to the process of claim 1.

35. A method of precipitating calcium carbonate, comprising:

(a) providing a substrate;

(b) combining the substrate with preformed calcium carbonate and a slaked lime slurry; and

(c) carbonating the product of (b).

36. The method according to claim 35, wherein the substrate comprises particles.

37. The method according to claim 35, wherein the substrate comprises fibers.

38. The method according to claim 35, wherein the substrate is chosen from a mixture comprising particles and fibers.

39. A method of precipitating calcium carbonate, comprising:

(a) carbonating a mixture comprising preformed calcium carbonate and a first slaked lime slurry; and

(b) combining the product of (a) with a second slaked lime slurry.

40. The method according to claim 39, further comprising:

(c) carbonating the product of (b).

41. The method according to claim 40, further comprising:

(d) combining the product of (c) with a third slaked lime slurry.

42. A method of precipitating substantially discrete calcium carbonate, comprising:

(a) carbonating a first slaked lime slurry to form a precipitated calcium carbonate having a median particle size of at least about 0.6 µm;

(b) combining the precipitated calcium carbonate in (a) with a second slaked lime slurry; and

(c) carbonating the product of (b) to form additional precipitated calcium carbonate, wherein a substantial portion of the additional precipitated calcium carbonate is discrete.

43. The method according to claim 42, wherein the additional precipitated calcium carbonate in (c) has a median particle size of at least about 0.7 µm.

44. The method according to claim 42, wherein the additional precipitated calcium carbonate in (c) has a median particle size of at least about 1.0 µm.

45. The method according to claim 42, wherein the additional precipitated calcium carbonate in (c) has a median particle size of at least about 2.0 µm.

46. The method according to claim 40, wherein the additional precipitated calcium carbonate in (c) has a median particle size of at least about 2.4 µm.

47. The method according to claim 42, wherein the additional precipitated calcium carbonate in (c) has a BET surface area of about 6.0 m²g⁻¹ or less.

48. The method according to claim 42, wherein at least about 90% by weight of the calcium carbonate is discrete.

49. The method according to claim 42, wherein at least about 95% by weight of the calcium carbonate is discrete.

50. The method according to claim 42, wherein the first slaked lime slurry in (a) further comprises a substrate chosen from particulate and fibrous materials.

51. The method according to claim 42, further comprising:
(d) combining the product of (c) with a third slaked lime slurry.

52. The method according to claim 51, further comprising:
(e) carbonating the product of (d).

53. The method according to claim 52, wherein the product of (e) comprises precipitated calcium carbonate having a median particle size of at least about 2.4 µm.

54. A paper comprising a composition made according to the process of claim 42.

55. A method of precipitating calcium carbonate, comprising:
(a) carbonating a first slaked lime slurry to form a precipitated calcium carbonate;
(b) combining the precipitated calcium carbonate in (a) with a second slaked lime slurry;

(c) carbonating the product of (b); and
(d) combining the product of (c) with a third slaked lime slurry.

56. The method according to claim 55, further comprising:
(e) carbonating the product of (d).

57. The method according to claim 55, wherein the first, second, and third slaked lime slurries each comprises calcium hydroxide in a concentration ranging from about 2% to about 30% by weight relative to the total weight of the slurry.

58. The method according to claim 56, wherein the product of (e) comprises precipitated calcium carbonate having a median particle size of at least about 0.7 µm.

59. The method according to claim 56, wherein the product of (e) comprises precipitated calcium carbonate having a median particle size of at least about 1.0 µm.

60. The method according to claim 56, wherein the product of (e) comprises precipitated calcium carbonate having a median particle size of at least about 2.0 µm.

61. The method according to claim 56, wherein the product of (e) comprises precipitated calcium carbonate having a median particle size of at least about 2.4 µm.

62. The method according to claim 56, wherein the product of (e) comprises precipitated calcium carbonate having a BET surface area of about $6.0 \text{ m}^2\text{g}^{-1}$ or less.

63. A system for precipitating calcium carbonate, comprising:
at least one reactor;
at least one lime entry point for adding a slaked lime slurry to the at least one reactor;
a first gas entry point, for adding a carbon dioxide-containing gas to the slaked lime slurry;

at least one additional gas entry point downstream of the first gas entry point, for an additional carbonation; and

at least one vent point to release spent or unused carbon dioxide-containing gas.

64. The system according to claim 63, further comprising at least one additional lime entry point downstream of the at least one additional gas entry point.

65. A system for precipitating calcium carbonate, comprising:

- a first reactor;
- at least one lime entry point for adding a slaked lime slurry to the first reactor;
- at least one gas entry point, for adding a carbon dioxide-containing gas to the slaked lime slurry to form a precipitated calcium carbonate;
- at least one additional reactor connected to and downstream of the first reactor, for receiving the precipitated calcium carbonate formed in the first reactor; and
- at least one vent point to release spent or unused carbon dioxide-containing gas.